Space Weather Technical Forecast

Issued on Friday, 26 August 2022 at 12:11 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares Likely. Active electron fluence waning.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with the background X-ray trace at GOES16 rising significantly into mid-C class, with flare activity of M1.8 recorded at 25/1951UTC, followed by an M1.0 at 25/2327UTC and an M2.1 at 26/1055UTC. All of these flares arose from sunspot region 3089 in the southeastern quadrant, which manifested as a Dai/Beta Gamma by the period's end with a growing tendency evident in its trailers as well as a sharply-defined magnetic neutral line. There was another notable sunspot in the southwestern quadrant, AR3088, which has undergone a similar lifecycle at a similar solar latitude, although this group appears more complex with Dkc/Beta Gamma classification. This group produced several C-class events, with a probable Coronal Mass Ejection (CME) emitted by the C7.3 generated at 26/0629UTC. this was evidenced by a dimming seen in AIA 211 imagery, however the corroborating coronagraph imagery is not yet available.

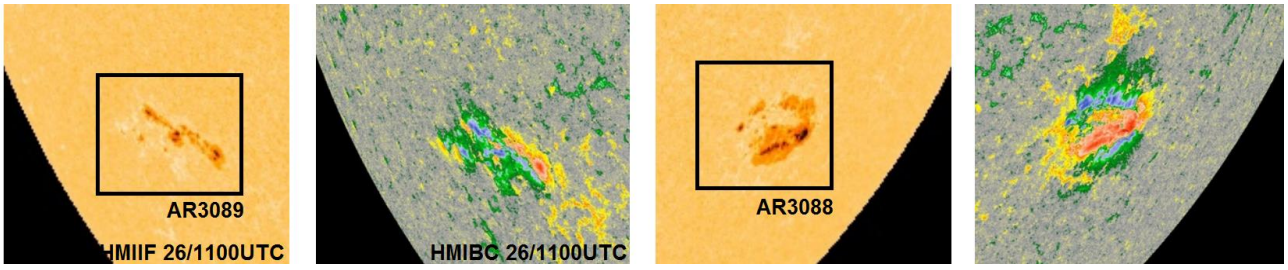


Figure 0: HMIIF and HMIBC of the two main sunspot groups on the disc at 26/1100UTC. Both have title magnetic neutral lines towards an East-west orientation, meaning shear from differential rotation may play a part in their development.

As for other potential CME-producing events in the period, there was a minor possible disappearing filament in El Teide H-Alpha imagery around 25/1530UTC, however this could not be reconciled with any ejecta, and no Earth-bound CMEs were therefore thought to be in evidence.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was characteristic of a slow solar wind regime. The solar wind speed showed an overall decline from early highs near 400km/s to reach 325. The solar wind density was within the scope of normal background activity, with a slight upward tendency in single-figures ppcc. The IMF was smooth an below 7nT throughout, while the north-south component ranged between +5 and -4nT. The phi angle was negative (towards the Sun) throughout. The net result of the above solar wind measures was for provisionally Quiet Kp indices throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES-16, was at Background levels.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

The high energy electron flux (greater than 2 MeV) remained at High levels, with a peak of 2800pfu at 25/1845UTC. The 24-hour integrated electron fluence remained above the Active threshold (1e8 integrated pfu) throughout the period, displaying a relatively flat trend. A value of 1.77e8 integrated pfu was observed at 26/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are Likely until the new UTC week, with a Slight Chance of an X-class flare, with a slight decrease on Monday 29 August the result of AR3088's departure, although AR3089 should remain present throughout (barring development). No new regions of note are due.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in this forecast. The coronal hole-based forecast is of lower than average confidence, but also probable lower than average consequence. Geomagnetic activity is expected to be mostly Quiet, with minor influence from CH18 possible on day two, Saturday 27 August, perhaps resulting in Active intervals. This should ease before a possible rise to a peak of a Slight Chance of a G1/Minor Storm on day four - should CH17 follow (Monday 29 August).

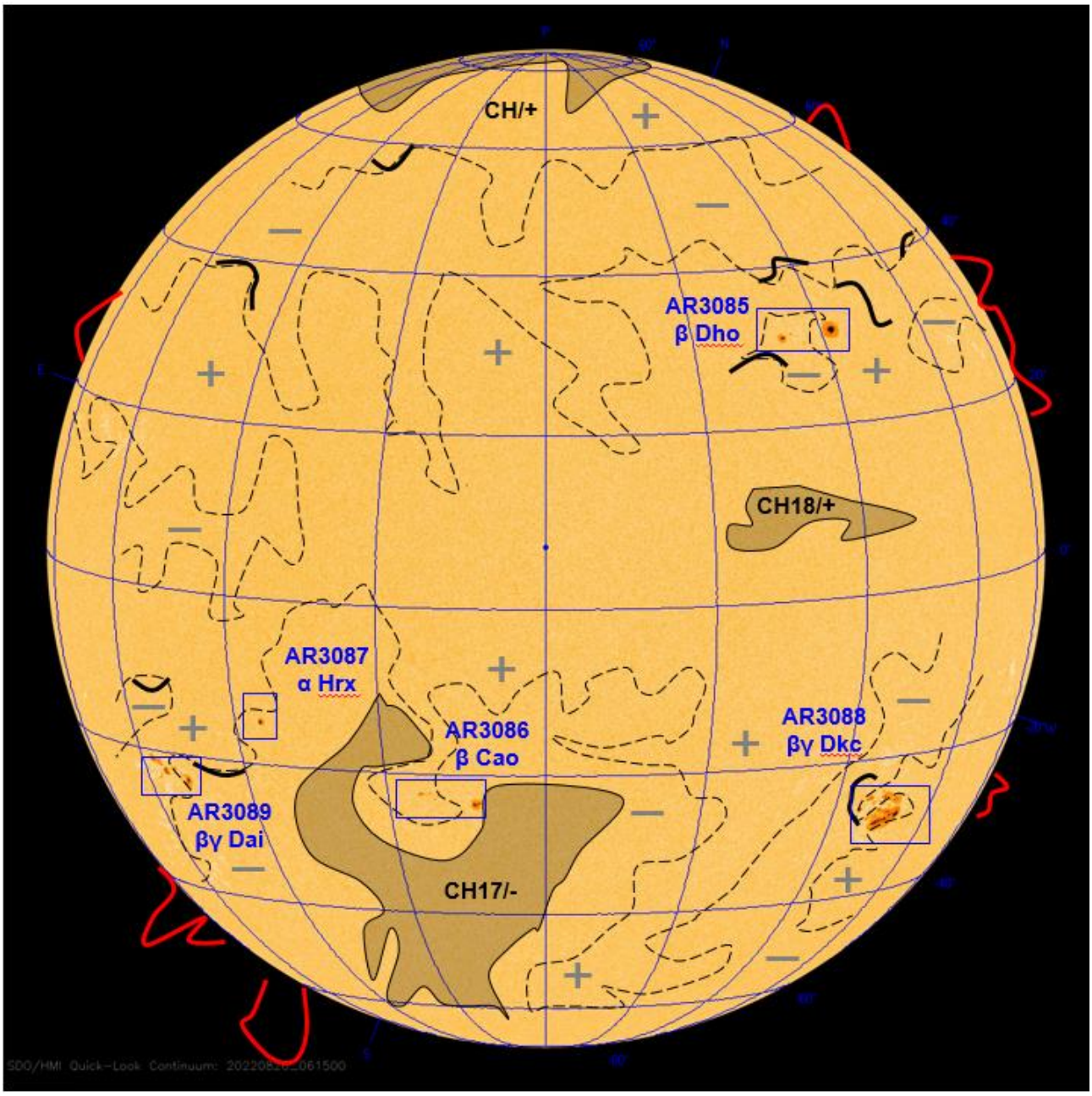
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is forecast to remain at Background levels but carries a daily Slight Chance of S1 or greater, due to AR3088 and AR3089.

The high energy electron flux (greater than 2 MeV) is currently at High levels but the outlook is for decline. The associated Active 24-hour fluence is expected to continue to show a decreasing trend, perhaps in a incremental fashion with arising geomagnetic activity from successive fast winds.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 26/0615UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No CMEs have been assessed as Earth-directed for this period.

Earth is currently in a sector of space characterised by a slow solar wind. Persistence methods would have nothing of note geomagnetic activity-wise for the next nine days, however MOSWOC Enlil hints that it expects a fast wind to become geoeffective from day two, Saturday 27 August. Hints of this enhancement at STEREO A are limited, perhaps suggesting a minor incipient fast wind of 400-450km/s, coupled with an IMF rising to near 15nT. Data gaps at this

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

satellite make diagnosing the feature responsible more difficult however.

The expected sequence of events from the disc alone is entry into the fast wind from minor CH18 on day two. The polarity of this hole is not clear-cut, however recent MOSWOC analyses suggest it may be positive (away from the Sun), which would rule out the recent STEREO measurements as being related. The tenure of any arising fast wind is expected to be brief, before a probable more marked entry into CH17's fast wind at the end of the four days. The main uncertainty with this second feature is its relatively low solar latitude, with Earth nearing its annual maximum distance north of the solar equatorial plane in the next month making any effect still more marginal.

Overall, confidence in the coronal hole-driven forecast is lower than typical. Geomagnetic activity is expected to be mostly Quiet, with Unsettled or perhaps Active intervals on day two, Saturday 27 August, probably easing somewhat before a peak Slight Chance of G1/Minor Storm later on day four, Monday 29 August - should CH17 prove geoeffective.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

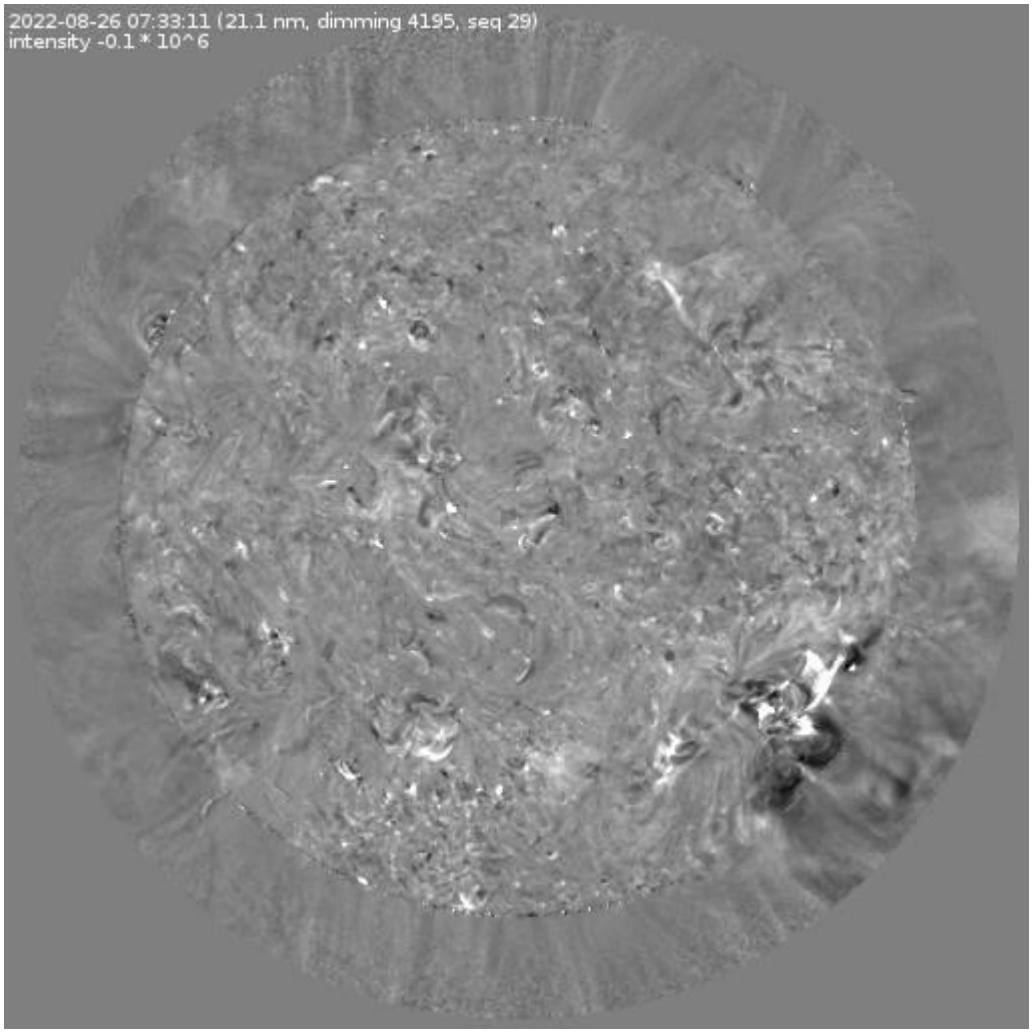
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: Aftermath of the 26/0629UTC C7.3 from AR3089 in time-integrated AIA 21 imagery, showing a possible CME candidate that is to be confirmed. Imagery processing courtesy of ROB SIDC.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

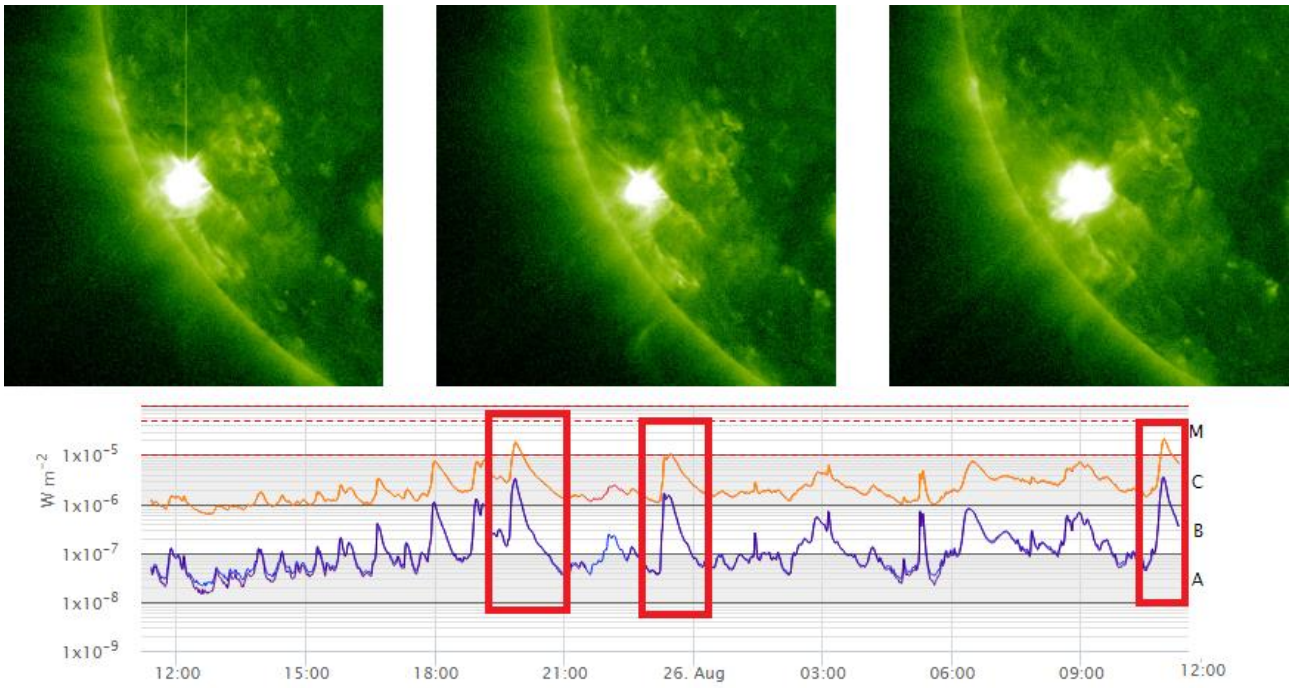
Solar activity has been Moderate over the past 24 hours, with much of the recent upsurge in activity down to the two southern solar hemisphere sunspots, AR3088 and AR3089 in the southwestern and southeastern quadrants respectively.

Both of these regions have sharply-defined magnetic neutral lines with a latitudinal orientation, which may give a degree of shear instability as well as their rapid growth trends, relative compactness (especially AR3088) and development of trailing spots.

Regarding the balance of front-sided groups and daily risk of flares, AR3088 should depart on day four, Monday 29 August, with the beginnings of a step-wise decrease in risk shown. On the eastern solar horizon, neither far-side soundings nor STEREO A EUVI 195 imagery suggest that there is anything imminent arriving, and so the overall trend in flare risk is constant until after the weekend, whereupon it should fall (barring significant development).

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	60	60	50
Very Active	R3 to R5 X Class	No	10	10	10	5

Figure 3: AIA094 extreme UV (X-ray proxy) of the three M-class X-ray flares in the period, all arising from AR3089. Also shown is the X-ray trace at GOES16, with the flares boxed in red.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels.

Given the complexity and rapid development of AR3088 in the southwestern quadrant in the past 36 hours, the chances of solar radiations storms are increasing, bolstered still further by AR3089 in the southeast. Neither has a recent history of even slight proton enhancment, but this is afforded little weight given their short tenure on the disc, and because of the more active AR3089's probable excessively eastward position (to connect) at present.

AR3088 should leave the disc on day four, Monday 29 August, however it will still contribute from the far side into the following week, with the risk from AR3089 then rising as 3088's falls.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as measured by GOES16 has shown a slight attenuation day-on-day now the high speed stream that generated current flux levels has waned. The increasing prospect of minor geomagnetic activity arising from coronal hole 18 is likely to dent counts and redistribute electrons on day two, Saturday 27 August, with any recovery unlikely in the period for lack of a suitably strong driving mechanism - coronal hole 17 does not feature until the end of the current four-day period.

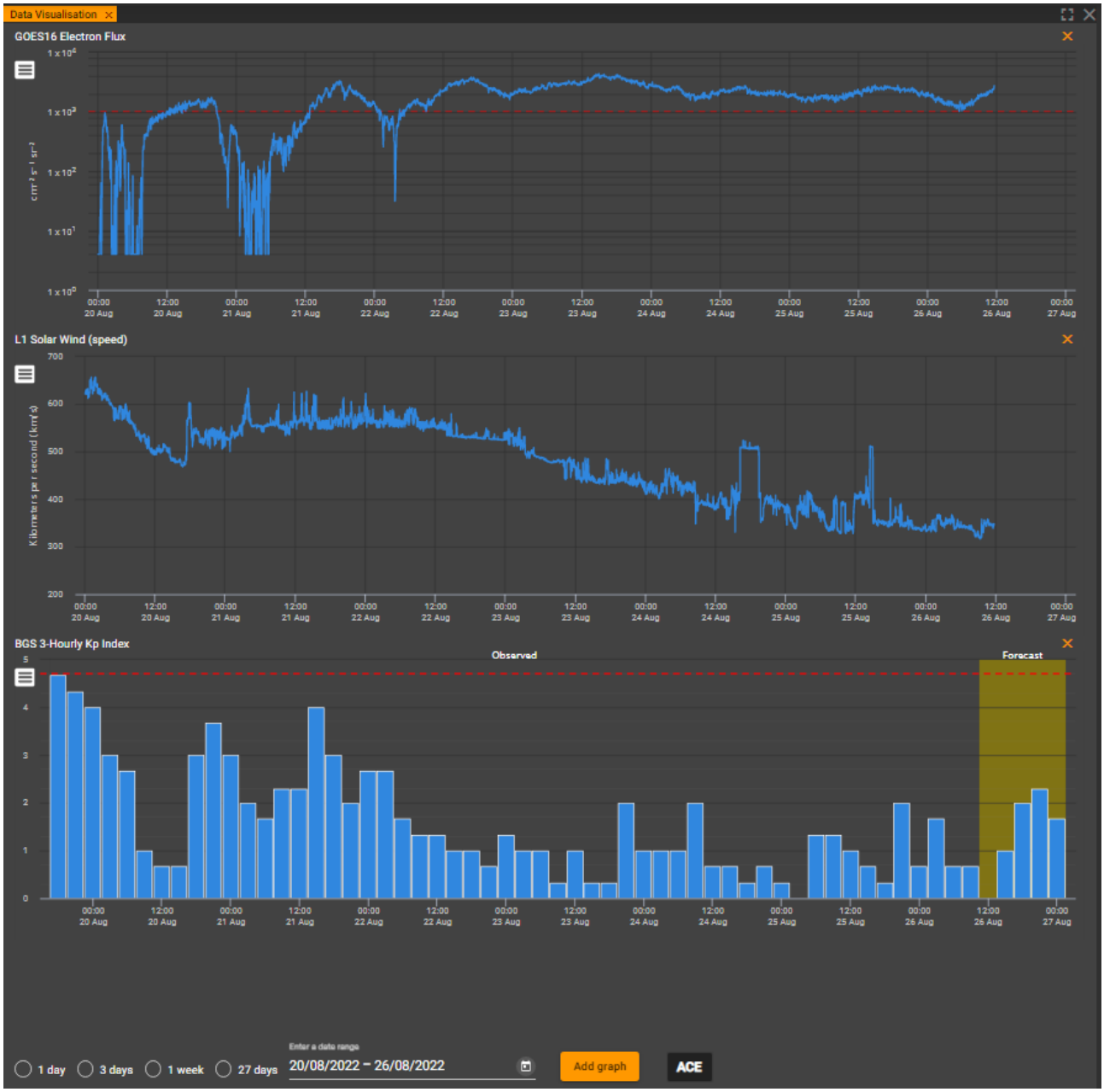
Active electron fluence is Expected to continue in the immediate term, with the chances of this being maintained falling throughout the four days in the less supportive environment, perhaps in step-wise fashion as CH18 and then CH17's geomagnetic activity temporarily perturb the belts.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	40	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 4: The past week in high energy electron flux at GOES16 (top), driving L1 solar windspeed (DSCOVR, middle) and geomagnetic activity (BGS-derived, 3-hourly Kp indices shown). The expected course of flux is downwards in the coming four days.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.